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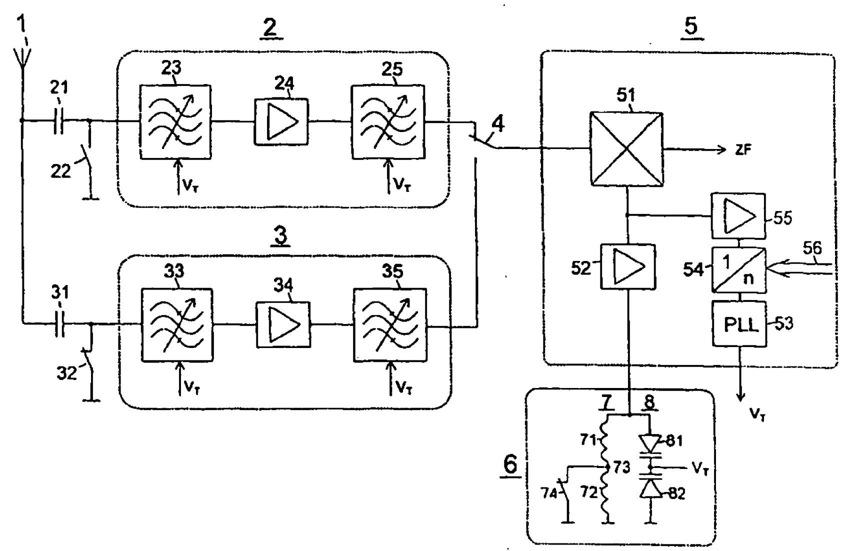
(54) Title: RADIO RECEIVER EQUIPMENT

(54) Bezeichnung: RUNDFUNKEMPFANGSGERÄT

(57) Abstract

The invention relates to a radio receiver device having a tuning stage (2, 3) that can be varied with a tuning signal (V_T) and is connected to a receiving antenna (1), a frequency converting stage (5) with a mixer oscillator (6) that may be controlled by the tuning signal (V_T) for converting the high frequency signals received to a defined intermediate frequency (ZF) and post–processing stages to form an audible low frequency signal. Said equipment can be used in different countries without loosing the tuning characteristics of the tuning stage (2, 3) for different band ranges due to the fact that at least two tuning units (2, 3) are connected to the receiving antenna (1), which can be effectively switched separately and whose outputs are connected to the common frequency converting stage (5) by means of a switch (4) and due to the fact that the variable range of the mixer oscillator (6) is configured in such a way as to be switched when switching to one of the tuning units (2) is effected.



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RADIO RECEIVER

The invention relates to a radio receiver having a tuning stage that is connected to a receiving antenna and that can be variably tuned using a tuning signal, a frequency conversion stage having a mixing oscillator that can be controlled by the tuning signal for converting the received high-frequency signals into a defined intermediate frequency position, and having additional processing stages for the formation of an audible low-frequency signal.

For many years, radio receivers have been equipped with a construction of this design. The respective tuning stage is dimensioned such that with the aid of the tuning signal the variable tuning is enabled over a relevant reception range. In a corresponding manner, the mixing oscillator of the frequency converter stage can be variably tuned in order to convert the high frequency selected using the tuning stage into the intermediate frequency defined in the radio receiver device. In order to achieve good tuning characteristics, in this context tuning stages are preferably used that are made up of a first variably tunable tuning circuit, an amplifier stage, and a second variably tunable tuning circuit.

Since in different countries different reception ranges are allocated, for example, for VHF reception, it is necessary to construct the radio receiver devices for the countries in question as different types in order to enable an optimal matching of the tuning stage used to the frequency band used in the country in question. This leads to the necessity of warehousing separate types of radio receiver devices. In the case of automobile radios, there arises the additional disadvantage that when the automobile in question is brought into a corresponding different country, radio reception with the built-in car radio is only partially possible, or is no longer possible at all, without modifying the radio.

For example, the frequency band for VHF reception in the European countries is located between 87.5 and 108 MHz, whereas the comparable frequency band in Japan is located between 76 and 90 MHz. It can be seen that a receiver provided for Europe will, in Japan, be able to receive only a small edge region of the frequency band used there.

A broader design, conceivable in itself, of the tuning stage in order to cover the entire frequency band in question – between 76 and 108 MHz – would be possible at a reasonable expense for the tuning circuit only at the expense of the tuning characteristics of the tuning stage, and is therefore not a possibility.

The invention is therefore based on the problem of constructing a radio receiver of the type named above in such a way that the reception of radio signals of the same type, in particular VHF signals in different bands having band boundaries that differ from one another and that in general overlap, is possible without loss of the tuning characteristics of the tuning stage.

On the basis of this problem, a radio receiver of the type named above is according to the present invention characterized in that at least two parallel tuning units are connected to the receive antenna, which units can be switched effective separately and whose outputs are connected with the common frequency converter stage via a changeover switch, and in that the mixing oscillator is constructed to be switchable by a changeover switch to one of the tuning units in its tuning range.

The radio receiver according to the present invention is, thus, a multi-norm receiver that can in particular receive VHF radio transmissions in bands having different band boundaries. For the bands in question having different band boundaries, at least two parallel tuning units are provided that can be switched effective separately, so that feedback to the other tuning unit can be prevented.

With the selection of the effective tuning unit, a corresponding changeover of the mixing oscillator is carried out in the frequency converter stage. For this purpose, the mixing oscillator is usefully provided with a tap that can be switched effective or ineffective for the purpose of the changeover.

The invention thus enables the radio receiver to be operated in different countries in which different band boundaries are defined for the reception of radio signals of a particular type, for example VHF radio signals. Of course, the invention can also be used for different band boundaries in the medium-wave, shortwave, or long-wave ranges.

In a particularly useful specific embodiment of the present invention, the receiving antenna can be switched effective, via a coupling capacitor and a switch, only for the tuning unit connected with the frequency converter stage via the changeover switch. The respectively unused tuning unit is disconnected from the receiving antenna using the coupling capacitor, which can be connected to ground. Through the dimensioning of the coupling capacitors, it can be ensured that the disconnected tuning circuit does not influence the connected tuning circuit.

In a preferred specific embodiment of the present invention, the mixing oscillator is constructed so as to be able to be changed over, in such a way that for a receiving range of a first tuning unit its frequency can be adjusted below the receiving frequency by the intermediate frequency, and for a receiving range of a second tuning unit its frequency can be adjusted above the receiving frequency by the quantity of the intermediate frequency.

Through this selection of the frequency positions of the mixing oscillator, disturbing influences due to the oscillator frequencies can be reduced.

In the following, the invention is explained in more detail on the basis of an exemplary embodiment shown in the drawing.

The drawing shows a schematic representation of the tuning stages that are essential for the inventive radio receiver.

In the exemplary embodiment shown, two tuning units 2, 3 are connected in parallel to a receiving antenna 1. For this purpose, tuning units 2, 3 each have a coupling capacitor 21, 31 whose end that is not connected to the receiving antenna 1 can be connected to ground via a switch 22, 32. The connection point between coupling capacitor 21, 31 and switch 22, 32 is connected with a first tuning circuit 23, 33 that can be controlled by a tuning signal V_T. The output signal of this tuning circuit flows, via a preamplifier 24, 34, to a second tuning circuit 25, 35 that can be tuned using tuning signal V_T. The outputs of the two second bandpasses 25, 35 are connected with two contacts of a changeover switch 4, whose output contact forms an input of a frequency converter stage 5 that is fashioned as an integrated circuit. The frequency converter stage 5 has a mixing stage 51 at whose output the defined intermediate frequency

ZF appears, which frequency is 10.7 MHz for the VHF reception depicted here. A second input of mixing stage 51 is supplied with an oscillator signal that is produced by an oscillator stage 52, which is integrated in frequency converter stage 5, and by an externally connected frequency-determining oscillator circuit 6. Oscillator circuit 6 is composed, in a known way, of an oscillator coil 7 having two partial windings 71, 72, at whose connection point a tap 73 is provided that can be connected to ground parallel to partial winding 72, using a switch 74.

Parallel to oscillator coil 7, an oscillator capacitor 8 is connected to ground, said capacitor being made up, in a known manner, of two variable capacitance diodes 81, 82 connected in antiparallel fashion. Tuning voltage V_T can be supplied to the connection point of the two variable capacitance diodes 81, 82, the capacitance of variable capacitance diodes 81, 82, and therewith the frequency of oscillator 6, being adjustable through this voltage.

Tuning voltage V_T is produced in a known manner with the aid of a phase locked loop (PLL) 53, in which tuning signal V_T can be controlled via a controllable frequency divider 54, to which the output signal of the oscillator at the output of amplifying oscillator stage 52 is supplied via an isolating amplifier 55. For the purpose of tuning, the adjustment of frequency divider 54 is controlled in a known manner by a microprocessor (not shown), via a control bus 56.

Intermediate frequency signal ZF, produced in frequency converter stage 5, is further processed in the radio receiver device, in a sufficiently known manner, and is converted into a low frequency that can be reproduced by a loudspeaker, headphones, or the like.

The drawing shown indicates the settings of switches 22, 32, 4, 74 for the switching effective of first tuning unit 2. Due to opened switch 22, receiving antenna 1 is here connected with tuning unit 2, which is switched effective, via coupling capacitor 21, said connection achieving the coupling of the received signal into tuning unit 2. In this context, closed switch 32 effects the switching off and decoupling of second tuning unit 3 from receive antenna 1.

Through tuning circuits 23, 25, a standard selective filtering takes place, the mid-frequency of tuning circuits 23, 25 being set through tuning signal V_T. The receive signal selected in this way flows, via changeover switch 4, which is closed at the output of second tuning circuit 25,

into frequency converter stage 5, and is there supplied to mixing stage 51. The oscillator signal of frequency-determining oscillator circuit 6 is supplied to the second input of mixing stage 51 via amplifying oscillator stage 52. At oscillator circuit 6, due to closed switch 74 only partial winding 71, which determines frequency range and thus reception range, is effective. Inside mixing stage 51, the intermediate frequency signal is formed from these two signals, said intermediate frequency signal being used by the further processing stages to form an audible low-frequency signal.

In the exemplary embodiment shown, first tuning unit 2 can for example be designed for the VHF band used in Europe, between 87.5 and 108 MHz.

If, for example, the inventive radio receiver is to be used in Japan, where the VHF band is located between 76 and 90 MHz, a changeover is carried out to the switching effective of second tuning unit 3. In relation to the depiction in the drawing, for this purpose switches 22, 32, 4, 74 are each switched into the other position, so that receiving antenna 1 is henceforth decoupled from first tuning unit 2 by coupling capacitor 21 and closed switch 22, and the receive signal from receiving antenna 1 is processed in second tuning unit 3 via coupling capacitor 31. Apart from the fact that this tuning unit 3 is designed for the desired frequency range, for example between 76 and 90 MHz, the processing takes place in the same manner as was described above for first tuning unit 2. Changeover switch 4, which is henceforth closed to the output of second tuning circuit 35, connects second tuning unit 3 with frequency converter stage 5. Opened switch 74 has the effect that overall coil 7, formed from the connection in series of the two partial windings 71, 72, is effective in oscillator circuit 6, resulting in the required frequency changeover.

For the formation of tuning signal V_T, the microprocessor (not shown) sets the currently applicable divider ratios at frequency divider 54 via control bus 56.

The changeover of oscillator circuit 6 is preferably carried out such that for the receive frequency range of the first tuning unit (87.5 to 108 MHz) it can be variably tuned between approximately 98 and 119 MHz, in order to produce the intermediate frequency of 10.7 MHz. In this case, the frequency of oscillator circuit 6 is therefore higher than the frequency of the signals received at receive antenna 1.

For the receive band of second receiver unit 3 (for example, 76 to 90 MHz), the variable tuning frequency of the oscillator is, in contrast, preferably located at 64 to 79 MHz; i.e., 10.7 MHz below the receive frequency.

The specified exemplary embodiment is provided for two different receive bands. Of course, it is unproblematically possible and useful to provide, for three or more receive bands, a correspondingly higher number of tuning units, and, if necessary, a corresponding number of changeovers of oscillator circuit 6.